MIELTA®
VEHICLE MONITORING

FANTOM

Fuel level sensor Mielta Fantom

BLE

USER MANUAL

Contents

1. Device Description

Mielta Fantom fuel level sensors (FLS) are designed for measuring fuel level in vehicle fuel tanks and stationary fuel storage facilities.

The operating principle of the FLS is based on the conversion of the electrical capacitance of the sensing element (capacitive sensor), which changes in proportion to the fuel level, into a digital code for transmission via the Bluetooth Low Energy (BLE) . interface

FLS are manufactured using metalworking technologies, powder painting, plastic injection molding and have a non-separable design.

FLS consist of a sensitive element (capacitive sensor) and a sealed durable plastic case, divided into separate cells for the electronic unit and battery. The housing cell with the electronic unit is sealed by pouring a polyurethane compound. The housing cell with the battery is sealed by filling it with a sealant compound, while access to the battery is maintained so that it can be replaced.

FLS do not have wired connections.

FLS have an integrated Bluetooth Low Energy (BLE) radio transmitter and a built-in high-performance antenna for transmitting level measurement results to connected mobile devices.

2. Metrological and technical characteristics

Characteristic name	Value
Measuring range depending on the length of the sensing element, mm	from 0 to 3000
Sensing element length, mm	from 150 to 3000
Limits of permissible level measurement error normalized to the measurement range, %	±1.0
Limits of permissible additional reduced error of level measurements when the ambient temperature deviates from normal measurement conditions in the range from minus 40 to plus 80 °C for every 10 °C	±0.2
Normal measurement conditions: - ambient air temperature, °C - temperature of the measured medium, °C	 from +15 to +25 from +15 to +25

Table 1. Metrological characteristics

☞ Mielta hereby declares that the radio equipment type FANTOM fuel level sensor complies with Directive 2014/53 / EU.

Characteristic name	Value
Working environments	Light petroleum products
Battery	Li-SOCL2 3.6 V, 2.7 Ah
Sensor type	Capacitive, linear
Accelerometer	Built-in
Pipe material	Steel
Electrode material	Stainless steel
Measurement period	from 1 to 10 s
Data sending period	from 1 to 10 s
Averaging interval	From 1 to 60 measurements
Wireless transmitter	Bluetooth Low Energy 5.0, 2.4 GHz
Frequency range	2400-2483.5 MHz
Transmitter power	Adjustable, up to <11 dBm EIRP
Inclination meter	Built-in accelerometer, 0-180°
Temperature meter	Built-in, +/- 2°C
Built-in memory	4 MB
Over-the-air software update and configuration	Yes
Degree of housing protection according to GOST 14254–2015	IP69k
Explosion protection marking	0Ex ia IIB T6 X
Operating conditions: - ambient temperature, °C - relative humidity, % - atmospheric pressure, kPa	 from - 40 to +80 from 45 to 80 from 84.0 to 106.7
Average service life, years	7
MTBF, h, not less	100000
Length of the sensitive element (probe), mm	from 150 to 3000
Case dimensions	76x80x25 mm
Sensor dimensions, mm	76x80x(25+Ls)
Sensor weight	250+(0.6*Li) ± 50 g.
Note – The following designation is accepted: L – probe length, mm.	

Table 2. Technical characteristics

☞ Mielta hereby declares that the radio equipment type FANTOM fuel level sensor complies with Directive 2014/53 / EU.

2.1 Power Supply

The Fantom FLS is equipped with a lithium-thionyl chloride battery with a voltage of 3.6 V and a nominal capacity of 2.7 A*h., which is designed for its entire service life, subject to the manufacturer's recommendations for setting the frequency of measurement and sending data.

The sensor determines its position in space in real time and when it deviates from the vertical by an angle of more than 60 degrees, the power saving mode is activated. The FLS turns off the meter and continues to transmit the last recorded value. While maintaining connectivity and customization. This way the sensor can be stored horizontally in the warehouse. Electricity consumption in this case is reduced to 10% of the nominal.

The functionality of the sensor is guaranteed in the battery voltage range from 3.0 V to 3.6 V.

After failure, the battery can be replaced in the Mielta production laboratory, for this you need to contact technical support.

> 👉 **Sensor versions starting from 2023 (with serial number higher than No. 11360)**
>
> To replace the battery yourself, you must purchase a **MIELTA Repair Kit** and make the replacement, following the video instructions or text instructions **(see. point 4.6)**

2.2 Level meter

The Fantom FLS is equipped with a unique integrated meter that converts the capacity of a linear sensor element into a digital value used in fuel level calculations. A fundamentally different method for measuring capacitance from competitors allows for measurements with high resolution and stability.

A new self-diagnosis algorithm has been implemented in emergency situations. When the measuring range specified during calibration is exceeded, together with an error code, the sensor displays the deviation value. Analysis of the error value can indicate the cause of the malfunction: incorrect calibration, changes in fuel properties, or water and dirt getting into the fuel.

2.3 Radio communication

The sensor is equipped with a modern integrated radio transmitter Bluetooth 5.0 Low Energy and a built-in high-performance antenna, which allows it to provide high quality radio communications with minimal power consumption. The parameters measured by the sensor are transmitted in a broadcast packet of the BLE standard **(Table 3)**.

Parameter	Valid values	Description
Level	From 0 to 10000	Fuel level value. Range is configurable, default 30 - 4095
	2xxxx	Error, level below minimum, where xxxx is the level reduction value as a percentage of the operating range
	3xxxx	Error, level above the maximum, where xxxx is the value of the level exceeded as a percentage of the operating range
	40000	Lack of calibration
Temperature	-50 to +100	FLS housing temperature, °C
	-127	Error, temperature below -50 °C
	+127	Error, temperature above +100 °C
Battery voltage	From 10 to 40	Battery voltage in volts multiplied by 10
	0	Error, voltage below 1.0 V
	255	Error, voltage above 4.0 V
Acceleration along the longitudinal axis of the sensor	-127 to +127	The angle of inclination of the sensor relative to the horizontal position is calculated by the formula α°=arcsin(Z/127).Parameter value: 0 – horizontal position; . +127 – vertical position, body up; . -127 – vertical position with the body down;

Table 3. Parameters

To control and change the sensor settings, its calibration and calibration, you must use any mobile device with Bluetooth version 4.2 or higher, as well as the configuration program for mobile devices **Mielta Device Manager (Mielta DM)** for the corresponding operating system **(Android, iOS)**. The program is available for free in the **Google Play** and **App Store**. app stores

2.4 Active protection

Fantom has a sensor built into its body that can detect attempts to cover it with any conductive material (metal) in order to destabilize or disrupt data transmission over the radio channel. Sensor data is analyzed, recorded in memory and transmitted to the terminal using a special protocol.

☞ Even if the user managed to block radio communication for some time, data about the fact of sabotage will be transmitted immediately as soon as communication is resumed.

3. Installation and connection

The sensor is mounted at the highest point of the container and opposite the lowest point of the bottom of the container. Preference is given to a location that provides minimal overlap of the space around the sensor housing with metal structures and has open access to the surrounding space. The sensor must be oriented around its axis in such a way that the priority direction of the antenna radiation **(Fig. 1)** was directed in the direction opposite to the maximum accumulation of metal structures.

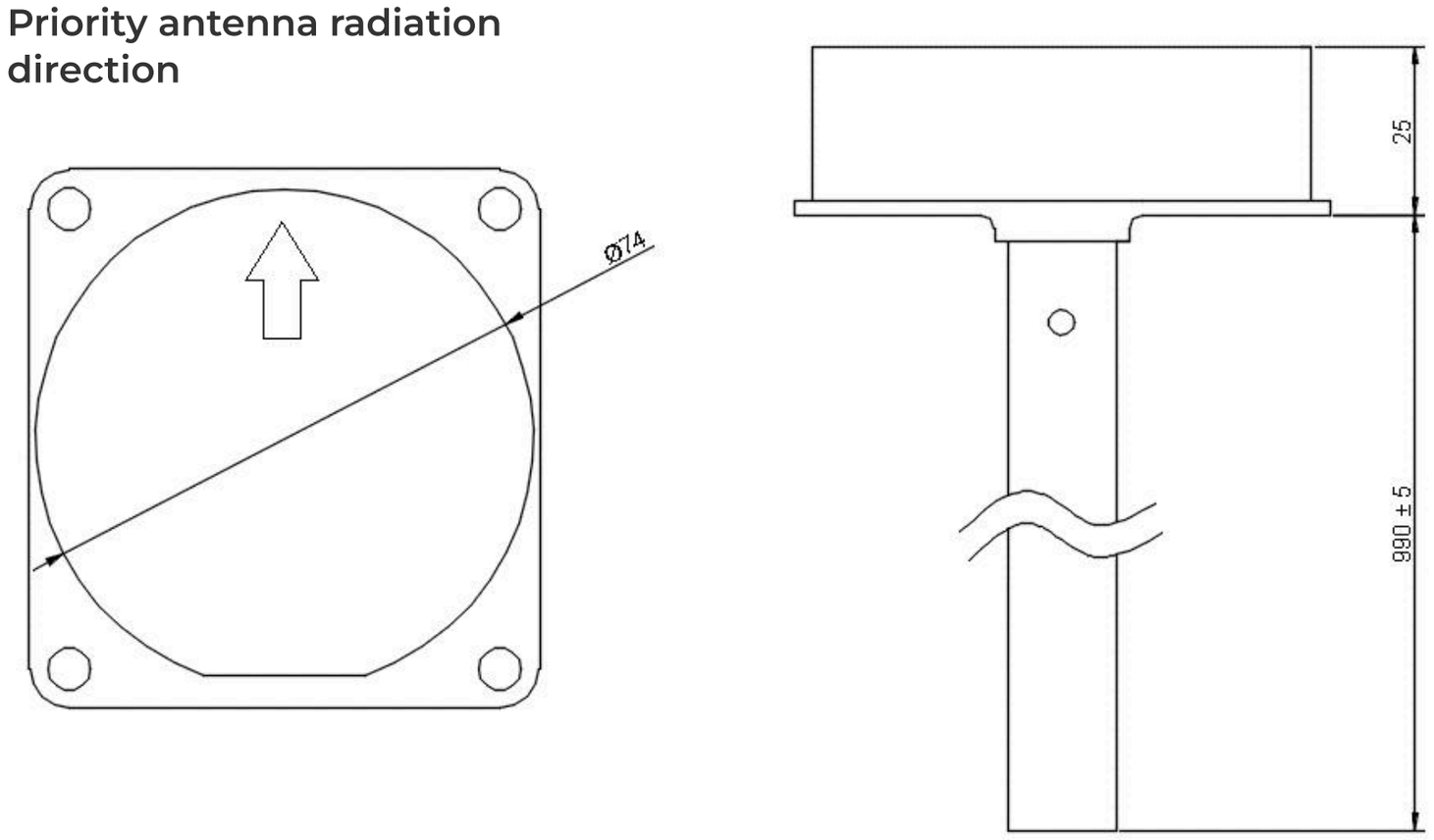

Figure 1. FLS installation dimensions

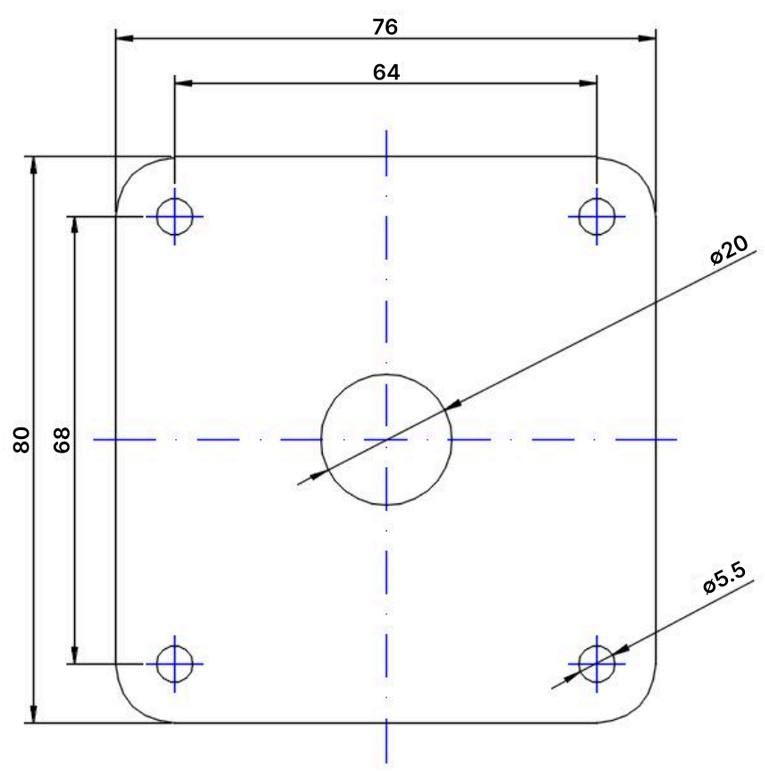

Figure 2. FLS mounting dimensions

The surface for mounting the sensor must be horizontal and selected taking into account the accessibility of the tool. The central hole must have a minimum diameter of Ø25 mm **(Fig. 2)**. The diameter of the mounting holes is selected based on the material of the container and the method of fastening.
Self-tapping screws are used to fasten the FLS. When installing on a metal tank, 4 holes with a diameter of 4-4.5 mm are drilled or screws with a drill are used. When installing in a plastic tank, 4 holes with a diameter of 3 mm are drilled and self-tapping screws without a drill are used.

Sequence of actions for installing the Fantom FLS:

1. Select a place for installation, clean it from dirt.

2. Mark the holes according to the template, drill, remove chips.

3. Measure the depth of the container from the bottom to the mounting surface.

4. Measure the length of the FLS from the mounting flange 20 mm shorter than the measured depth of the tank.

5. Saw off the tube and the central electrode, remove burrs, insert the plug insulator into the end of the measuring tube.

6. Calibrate the FLS.

7. Clean and degrease the mounting surface of the container. Apply sealant to the surface, glue the rubber gasket. Apply sealant to the gasket and install the FLS.

8. Secure the FLS with screws.

9. Seal the mounting screws with a wire seal.

☞ If necessary, to bypass obstacles in tanks of complex shape, the measuring tube of the sensor can be bent. Bending is carried out using specialized pipe benders with a bend radius of at least 250 mm. The bend angle should not exceed
15 degrees **(Fig. 3)**.

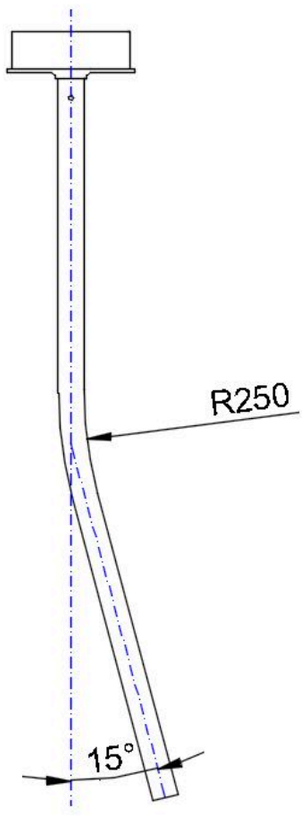

Figure 3. Bending the sensor tube

Sequence of actions when bending the sensor tube:

1. Calculate the bend location and mark it on the tube.

2. Place the sensor tube in the pipe bender with the mark in the middle.

3. Open a connection between the FLS and the mobile configurator and monitor the reading of the Level row. value

4. Bend the tube until the required angle is reached, avoiding short circuit between the central electrode and the tube.

5. When closing the electrode and the tube, it is possible to reduce the bend angle by applying force to the bend on the reverse side until guaranteed isolation of the electrode from the tube is achieved.

6. Cut the tube to the required length.

7. Calibrate, install and calibrate the sensor.

☞ If necessary, the sensor tube can be bent in two or more places to give it a complex shape.

⚠ It is worth considering that the tube, being bent, loses its symmetry and linearity, which directly affects the sensor readings. A bent sensor without calibration may have nonlinear distortions in the readings at different levels. When calibrating the sensor, it is recommended to increase the number of measurement points (30-50 points per meter) to compensate for nonlinearity.

4. Sensor setup

To configure the sensor, use the **Mielta Device Manager** configurator program, available free of charge in the **Google Play** and **App Store** application stores. For full operation, you must confirm all permissions requested by the program.

After installing and launching the program, on the **“Connection”** tab, a search window for BLE devices **will be displayed (Fig. 4)**. Shift down activates another search. The Fantom FLS in the list of found devices will have a name consisting of the prefix **“MD”** and the last 4 digits of the serial number. When you select one sensor from the list, the parameters window opens**(Fig. 5)**which displays all the data transmitted by the sensor in normal mode at a specified interval.

To configure the sensor, two-way connection must be activated. In this mode, the sensor produces an extended list of parameters in real time **(Fig. 6)**.

The fuel level value is **2048** if there are no calibration parameters, it is necessary to calibrate.

In the upper right corner of the window there is a data reception indicator **“Link”**. The indicator flashes green every time a data packet arrives from the sensor. In connected mode, data is transferred faster, the indicator is constantly lit .

Figure 4. Search window

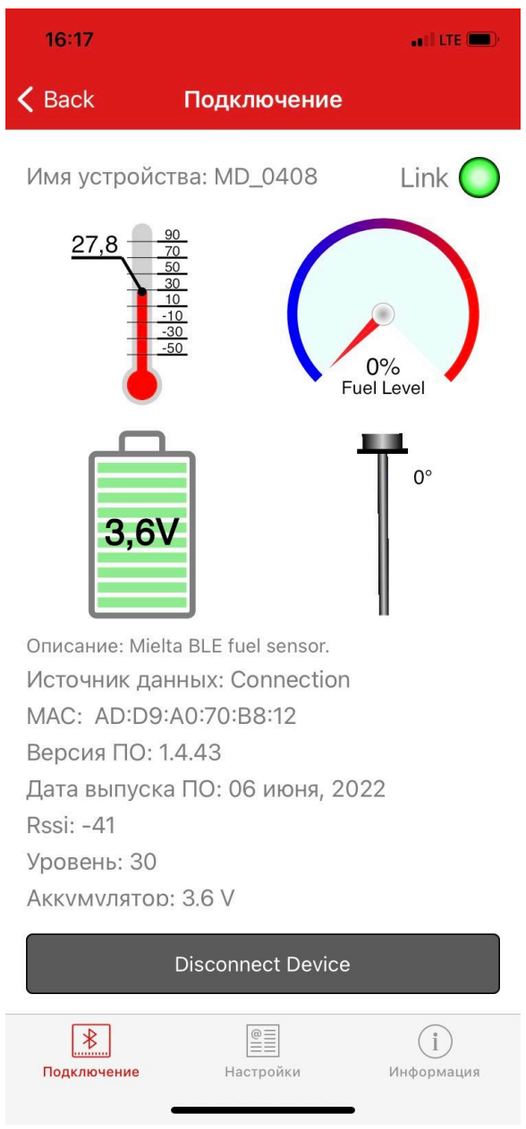

Figure 5. Options window

Figure 6. Connection established

The “Settings” tab shows a list of settings **(Fig. 7)**.

Basic settings include calibrating the fuel gauge, transmitter settings, and setting the date and time.

Figure 7. List of settings

4.1 Calibration

The “empty tank” and “full tank” calibration values define the measurement range in arbitrary units, which is scaled within the specified output value range. Calibration is carried out after cutting the measuring tube to the required depth and installing the insulating plug .

First, a “full tank” calibration is performed by dipping the sensor into a container of fuel to the level of the drain hole. After the current meter value has stabilized, this value is written to parameter **(Fig. 8)**.

The second stage is the “empty tank” calibration.. To do this, you need to remove the FLS from the fuel and allow the remaining fuel to drain from the tube for 5 minutes. After stabilization, the meter value for an empty tank is fixed in the corresponding parameter.

> When performing an “empty tank” calibration without first wetting the sensor tube with fuel, the operating range will be incorrectly set.

If necessary, calibration values can be entered manually in the corresponding window block **(Fig. 8)**

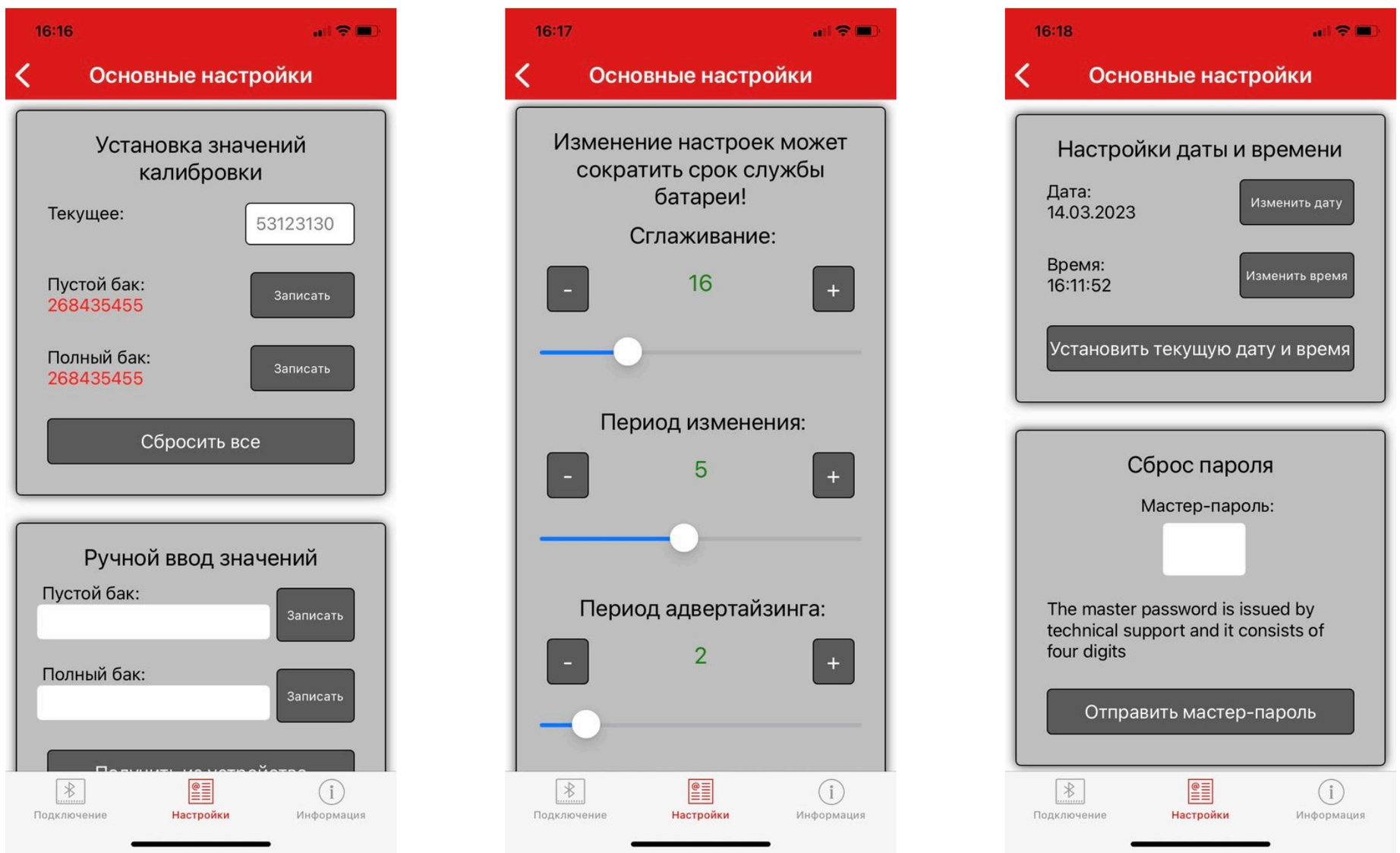

Figure 8. Basic settings

4.2 Taring

Calibration of the Fantom fuel level sensor is carried out in the mobile application **MieltaDM (iOS, Android)**, which you can download from **Google Play** or **AppStore** respectively.

To calibrate the fuel level sensor after connecting to the FLS and calibration has been completed, you must go to the tab - **Manual calibration**. After calibration is completed, a **PDF**, **CSV** or **WLN** file will be created in the file system of the mobile phone in the installed folder **MieltaDM** (depending on the selection in the upper right corner of the required format), which can be used (a table file in **PDF**, **WLN** or **CSV** format can be shared by clicking the button - **“Share calibration file”**).

Taring sequence:

1. Install the sensor in an empty fuel tank, making sure there are no fuel residues at the bottom of the tank.

2. Click **“Start calibration”**, after which the first calibration line will appear automatically for the zero value (this must be a value close to **Level 30**, which corresponds to **0** liters of real level). If necessary, the created line can be deleted by clicking the corresponding button. At the same time, under the bottom line you can observe the value of the current level and its stability (if the level is not stable or the value does not increase at the next step, the next tare line will not appear and a corresponding warning will be displayed)**(Fig. 9)**.

Figure 9. Start of manual tare

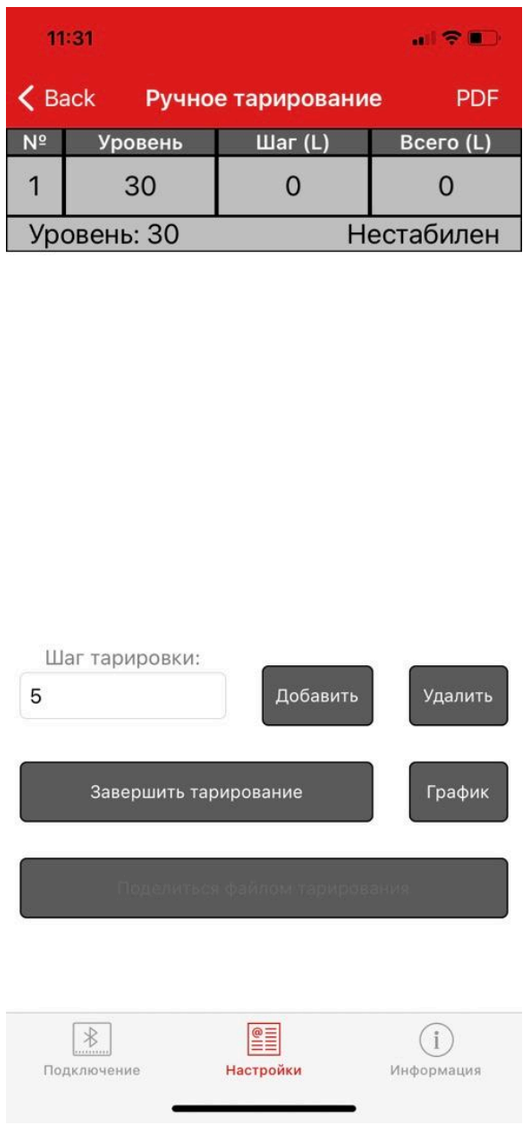

Figure 10. Selecting the manual tare step

3. To add a line, you need to enter in the field **“Calibration step”** the value of the real volume of fuel poured into the fuel tank, for step-by-step recording of the real value of the fuel level and **level** of the displayed FLS, in order to subsequently enter this calibration table into the monitoring system. Then click on the button - **“Add”** and the fuel level values and frequency will be calculated automatically. The calibration step value may vary depending on the capabilities of your installation team and the size of the fuel tank **(Fig. 10)**.

4. Upon completion of tare (having reached the level of the upper limit **4095** or if you are sure that the level will overflow at the next step), you can click **“Finish tare”** within the limits of values close to **4095** or enter a tare step in the field **“Tare step”** a lower value and add fuel from . smaller step value. After recording the last line, you must click the **“Finish calibration” button**, and a calibration table in the selected format **(PDF, CSV or WLN)** is created in the phone’s file system, which you can share or send by email.

☞ You can also check the linearity of your table by clicking on the **“Graph”** button. If the line is relatively straight and does not have complex shapes, then the calibration was successful.

After the calibration has been completed, you can copy the files from the **MieltaDM** application folder and send them to the desired addressee on the network, or click the **“Share calibration file” button** and send the table to the desired recipient.

4.3 Smoothing

To reduce fluctuations in the level value, the sensor has a parameter**“smoothing”**.
This parameter sets the number of last measurements to calculate the average value **(Fig. 8)**. The parameter has a range of valid values from **1 to 60**. The default value is **12**.
For some types of equipment or tanks without partitions, this parameter may have a value of more than **30**.

4.4 Measurement and transmission

The values of the measurement period and transmission period (advertising) directly affect the speed of the sensor’s response to level changes and its energy consumption. These parameters must be in the range **1 to 10**.

The default values are: measurement period - **5 seconds**, transmission period - **2 seconds**. These values are used in calculating the guaranteed operating life from one battery.

⚠ Changing the parameters, frequency of measurement and transmission to smaller ones, increases battery consumption manifold and shortens the life of the sensor. The manufacturer does not guarantee service life if these parameters are reduced.

4.5 Transmission format and power

The transmitter power parameter can be in the range from **0 to 49**. The default value is **24**. Increasing transmitter power in some situations can improve communication quality. However, the location of the FLS and the receiving terminal relative to each other and shielding metal structures has a much greater impact on the quality of communication.

☞ An increase in transmit power also leads to increased battery consumption.

FLS Fantom supports two data packet filling formats:

Option 0 (default) – Mielta format;
Option 1 - similar sensor from another manufacturer.

4.6 Replacing the battery

In the new version of the Fantom FLS released **starting from 2023 (serial number 11360 and higher)** you can replace the battery yourself. To replace the battery, you must purchase a **Repair Kit** by contacting the **MIELTA** sales office and make the replacement following the instructions **(see below)**.

To replace you will need:

- MIELTA repair kit
- Screwdriver set
- Knife
- Pliers
- Soldering iron
- Disposable container and spatula (for mixing silicone)

Instructions for replacing the Fantom FLS battery:

1. Unscrew the screws, use a knife to lift the cover of the battery compartment.

2. Remove the expired battery, bite off the power wires from the battery and unsolder the bitten off power contacts from the FLS board.

3. Clean the battery compartment from any remaining compound.

4. Take a new ER-14505 battery from the Repair Kit and solder the wires to the power contacts on the Fantom. FLS board

5. Place the battery in the compartment.

6. Mix the components of the compound from the Repair Kit in a disposable container and fill the battery compartment of the sensor.

7. Screw on the battery compartment cover and allow time for the compound to polymerize.

8. The sensor is ready for operation.

Also, to replace the Fantom FLS battery yourself, you can follow the detailed video instructions on our **Youtube channel:**

Point your smartphone camera

5. Transportation and storage

The fuel level sensor must be stored in a warehouse at a temperature from -20° C to +50° C and a relative humidity of no more than 85%. Ingress of conductive dust, water and technical liquids is excluded. Transported in original packaging, by any means of transport.

6. Warranty

The manufacturer guarantees the performance of the fuel level sensor for 3 years from the date of production, subject to the consumer's compliance with the conditions and rules of transportation, storage, installation and operation. Average service life 7 years.

The warranty period for the battery is 3 years from the date of manufacture.

The warranty does not apply:

- on FLS with mechanical damage and defects (cracks, chips, dents, traces of impacts, thermal, electrical and chemical effects) caused by the consumer or third parties due to violation of operating conditions, storage or transportation);
- on the FLS with traces of repair outside the manufacturer’s service center;

> 👉 With the exception of traces after replacing the battery for the new version of sensors released starting in 2023

- on the FLS that failed due to incorrect software update.

7. Delivery set

Name	Quantity
Mielta Fantom fuel level sensor	1 piece
Kit of mounting parts	1 piece
Package	1 piece
Instructions for Use	1 piece
Passport	1 piece

Technical support:

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